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METHODS OF OBTAINING AMMONIUM PHOSPHATE AND ITS AREAS OF APPLICATION

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Abstract. *Ammophos is an effective mineral fertilizer that combines nitrogen and phosphorus, widely used in agriculture. Its production is mainly carried out by reacting phosphorous raw materials with ammonia. Granulation technology ensures the product is prepared in a convenient form. This fertilizer plays a significant role in increasing crop yields and improving soil fertility. Ammophos is utilized in agriculture for various crops, including grains, vegetables, and fruit trees. Additionally, it is applied in the chemical industry and environmental sectors. Due to its optimal composition and efficiency, ammophos is highly valued as a universal fertilizer [3-4].*

Keywords: *Ammophos, chemical reactions, granulation method, monoammonium phosphate, diammonium phosphate, ballast components, extraction, thermal, dicalcium phosphate, gypsum.*

СПОСОБЫ ПОЛУЧЕНИЯ АММОФОСА И ОБЛАСТИ ЕГО ПРИМЕНЕНИЯ

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Аннотация. *Аммофос — это эффективное минеральное удобрение, содержащее азот и фосфор, которое широко используется в сельском хозяйстве. Его производство осуществляется преимущественно путем взаимодействия фосфорсодержащего сырья с аммиаком. Технология грануляции обеспечивает удобную форму выпуска продукта. Данное удобрение играет важную роль в повышении урожайности и улучшении плодородия почвы. Аммофос применяется в сельском хозяйстве для различных культур, включая зерновые, овощи и плодовые деревья. Кроме того, он используется в химической промышленности и экологических сферах. Благодаря оптимальному составу и эффективности аммофос высоко ценится как универсальное удобрение [3-4].*

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Ключевые слова. *Аммофос, химические реакции, метод грануляции, моноаммонийфосфат, диаммонийфосфат, балластные компоненты, экстракция, термический, дикальцийфосфат, гипс.*

AMMONIY FOSFAT OLISH USULLARI VA UNING QO‘LLANISH SOHALARI

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Annotatsiya. *Ammofos – azot va fosforni o‘zida jamlagan samarali mineral o‘g‘it bo‘lib, qishloq xo‘jaligida keng qo‘llaniladi. Uni ishlab chiqarish asosan fosforli xomashyolarni ammiak bilan reaksiyaga kiritish orqali amalga oshiriladi. Granulyatsiya texnologiyasi mahsulotni qulay shaklda tayyorlashni ta’minlaydi. Ushbu o‘g‘it hosildorlikni oshirish va tuproq unumdorligini yaxshilashda muhim rol o‘ynaydi. Ammofos qishloq xo‘jaligida turli ekinlar, jumladan, g‘alla, sabzavot va mevali daraxtlarni parvarishlashda qo‘llaniladi. Bundan tashqari, kimyo sanoati va ekologiya sohalarida ham foydalaniladi. Optimal tarkibi va samaradorligi tufayli ammofos universal o‘g‘it sifatida yuqori ahamiyatga ega [3-4].*
Kalit so‘zlar: *Ammofos, kimyoviy reaksiyalar, Granulyatsiya usuli: ,monoammoniy fosfat, diammoniy fosfat, ballast komponentlar, ekstraksiya, termik, dikalsiyfosfat, gips.*

Introduction. Ammophos is a widely used complex mineral fertilizer, valued for its balanced composition of phosphorus and nitrogen. This fertilizer is instrumental in enhancing soil fertility, promoting plant growth and development, and significantly improving crop yields. In modern agriculture, the production and application of ammophos are critical for addressing key challenges such as the efficient utilization of land resources and maintaining environmental sustainability [5].

The production of ammophos involves processing phosphorus-rich raw materials, particularly phosphorites and apatites. Optimizing the technological efficiency of this process and implementing effective waste recycling solutions are essential not only for economic benefits but also for mitigating ecological concerns [2].

Beyond agriculture, the use of ammophos has extended to various fields within the chemical industry, including industrial, medical, and defense applications. This study examines the production technology of ammophos, its diverse applications, and measures to ensure its environmental safety. Furthermore, it identifies current challenges and future opportunities in the production of phosphorus fertilizers, emphasizing the need for innovative and sustainable approaches.

Literature Review. Ammophos is a concentrated mineral fertilizer containing nitrogen and phosphorus. It is produced in the form of gray granules with excellent physical and chemical properties: it does not cake, stick, clump, or absorb moisture, and it remains stable during storage without freezing. Ammophos is non-toxic, fire-resistant, and explosion-proof. It primarily consists of monoammonium phosphate ($NH_4H_2PO_4$), combined with diammonium phosphate $(NH_4)_2HPO_4$. The granular Ammophos contains at least 10% nitrogen and up to 45% phosphorus pentoxide (P_2O_5). It has no ballast components, dissolves in water, and possesses favorable physical characteristics. Ammophos can be applied to various soil types and is versatile for use as a liquid fertilizer by dissolving in water. Often, it is mixed with a substrate and applied in powder form when planting crops [6].

Research Methodology. The development of modern production is closely tied to the growing social demand for specific products, including mineral fertilizers. Ammophos is one of the most

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widely used complex fertilizers due to its high agrochemical efficiency and compatibility with other fertilizers [1]. This compatibility allows for the creation of blended fertilizers with any nutrient ratio based on Ammophos. Additionally, Ammophos production can utilize phosphate ores (containing 24–26% P_2O_5). It is derived from phosphoric acid, apatite concentrate, and phosphorites.

Production Methods of Ammophos. Ammophos is produced using the following key methods:

- Chemical Reactions: Reacting phosphorus-containing raw materials (phosphates or phosphoric acids) with ammonia.
- Granulation Method: The resulting products are prepared in granule form, making them more convenient for use as fertilizer.
- Thermochemical Methods: In some cases, reactions are carried out at high temperatures to improve product quality.

The full production name is the Ammophos Production Department of the Phosphorus Fertilizers Plant. The production method involves neutralizing orthophosphoric acid with gaseous ammonia, followed by granulation and drying in drum-type granulators and dryers (BGS). Ammophos is a dual-component nitrogen-phosphorus fertilizer obtained by neutralizing phosphoric acid with ammonia [10].

Key Characteristics and Applications. Ammophos is physiologically clean, as its NH_4^+ ions undergo nitrification in the soil, reducing acidity. It is effective on all soil types, particularly chernozem and chestnut soils. Ammophos is primarily used for the main application in technical crops. As a water-soluble fertilizer, it is also suitable for feeding vegetables, fruits, and grains. However, only a portion of Ammophos is used for direct application; the majority is utilized to prepare balanced blended fertilizers [15].

Environmental Considerations. The mineral fertilizer industry faces critical challenges, including the production of effective fertilizer types, recycling waste from phosphorus and complex fertilizer production, and developing environmentally friendly plant protection products [13]. Ammophos production addresses these issues, contributing to sustainable agricultural practices and ecological safety.

Analysis and Results. Ammonium phosphates are produced using ammonia and orthophosphoric acid (both extracted and thermal) as raw materials. The neutralization of phosphoric acid with ammonia is accompanied by the release of a significant amount of heat:

$$H_3PO_4(s)+NH_3(g)\rightarrow NH_4H_2PO_4(aq)+147\ kJ$$
$$H_3PO_4(s)+2NH_3(g)\rightarrow (NH_4)_2HPO_4(aq)+215\ kJ$$

When neutralizing extraction phosphoric acid containing 40% H_3PO_4 (~29% P_2O_5), the yield of crystals is relatively low, even at a temperature of 25°C (corresponding to point S in the system) **(**1-picture) [8]. In contrast, when concentrated phosphoric acid (75% H_3PO_4 or 54% P_2O_5) is neutralized, the system composition corresponds to point D. The amount of solid phase formed is highest even at temperatures above 75°C. This is facilitated by partial evaporation of water due to the heat of the reaction[12]. In the production of Ammophos, extraction phosphoric acid contaminated with impurities is used. During its neutralization with ammonia to a pH of ≥3, intermediate phosphates of iron and aluminum, such as $HPO_4{\cdot}2H_2O$, and iron-aluminum-ammonium phosphates, such as $NH_4(Fe,Al)(HPO_4)_2{\cdot}0.5H_2O$, are formed. Additionally, dicalcium phosphate ($CaHPO_4{\cdot}2H_2O$), gypsum, fluoride and fluorosilicate salts, and magnesium ammonium phosphate ($NH_4MgPO_4{\cdot}H_2O$) precipitate (2-picture). Ammonium sulfate forms in the liquid phase [7].

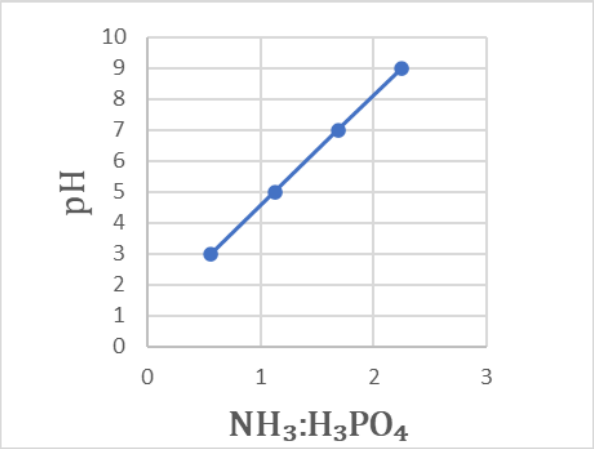

Figure 1. The relationship between pH value and the molar ratio of NH_3:H_3PO_4 in saturated solutions of ammonium phosphates at temperatures of 65-75°C.

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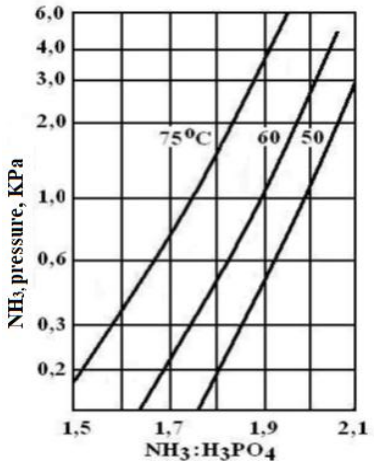

Figure 1. The relationship between ammonia pressure and the molar ratio of NH_3:H_3PO_4 in saturated.

Dosage and application rate of Ammophos. Long-term experience with the use of phosphorus fertilizers has shown that the highest yields of agricultural crops are achieved when the P_2O_5 content in the soil reaches 151-200 mg/kg [11]. The issue of phosphorus is exacerbated by the unique characteristics of its natural cycling, where it is separated from the soil with the crop in a one-way process. In this regard, D. N. Pryanishnikov (1924) stated, “Soil gradually, but steadily, loses its phosphorus (or at least its available portion), and beyond a certain limit, phosphorus becomes the limiting factor for obtaining a good yield”. A significant reason for the deterioration of the soil’s phosphate regime is the sharp decline in the consumption of phosphorus fertilizers in recent years [14]. Low fertilizer doses negatively impact the productivity of agrocenoses and soil fertility formation. Inadequate phosphorus supply not only reduces crop yield but also diminishes the absorption of nitrogen and other biogenic elements by plants [9].

Conclusion. Ammophos is an important mineral fertilizer in agriculture, known for its effectiveness for various crops due to the optimal ratio of nitrogen and phosphorus. Its production technology is multi-stage, resulting in a highly efficient product. This fertilizer is widely used not only in agriculture but also in the chemical industry and for addressing environmental issues.

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